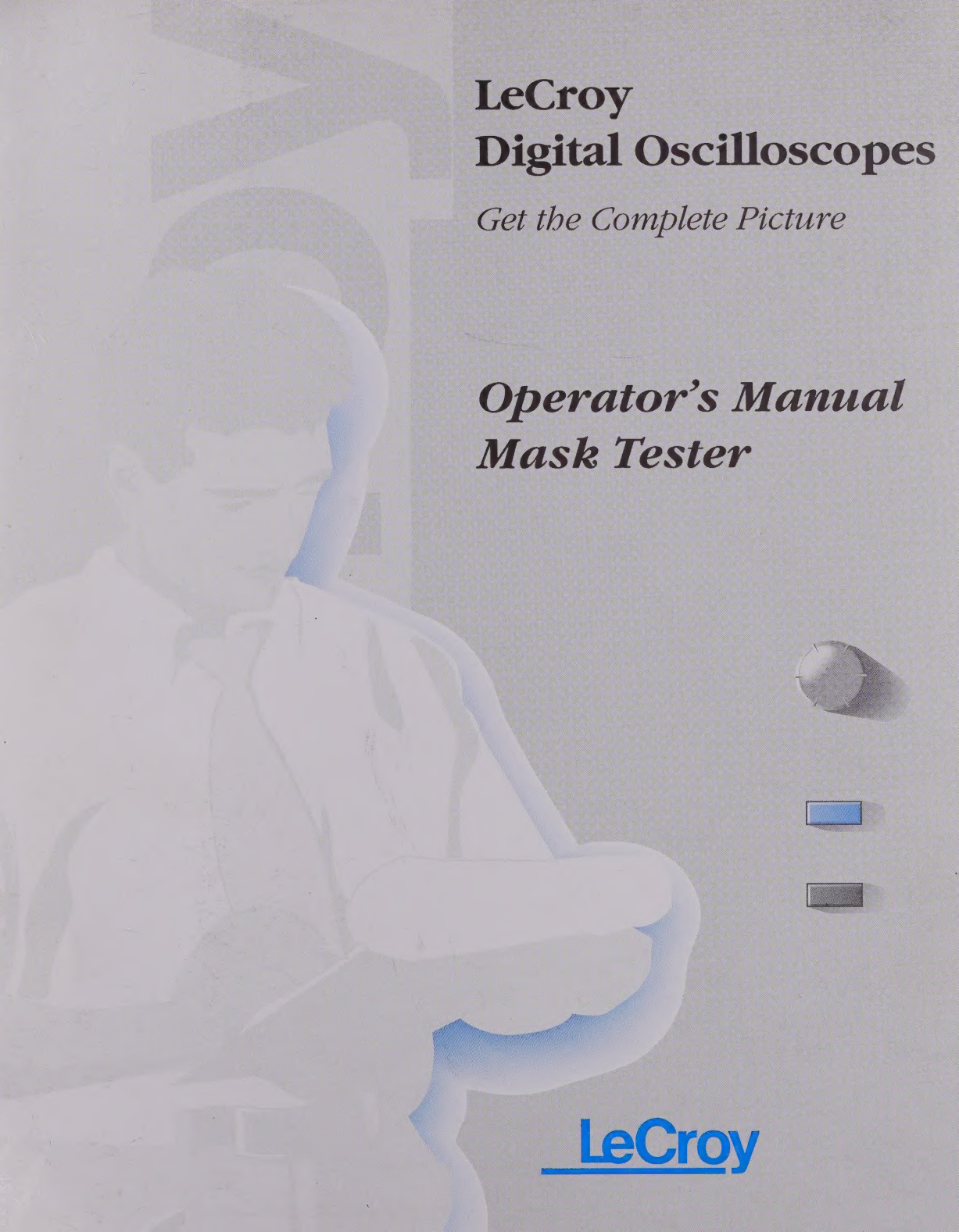




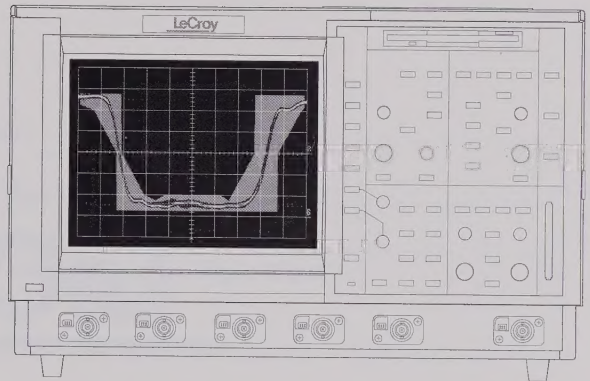
LeCroy Digital Oscilloscopes

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Operator's Manual Mask Tester



LeCroy



Operator's Manual

Mask Tester

for LeCroy

Digital Oscilloscopes

Revision B — May 1997

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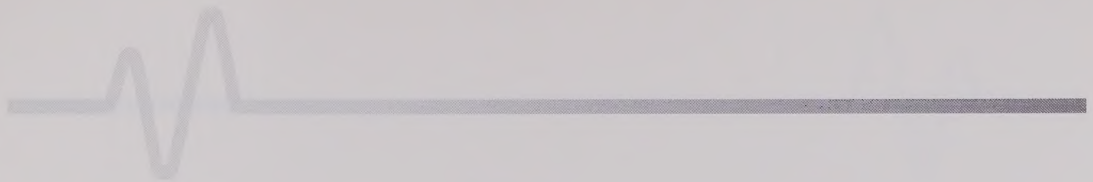
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Introduction

The Problem

Oscilloscopes are commonly used in the telecommunications industry to perform “Mask Testing” — a check of whether the signal shape falls within a particular defined tolerance.

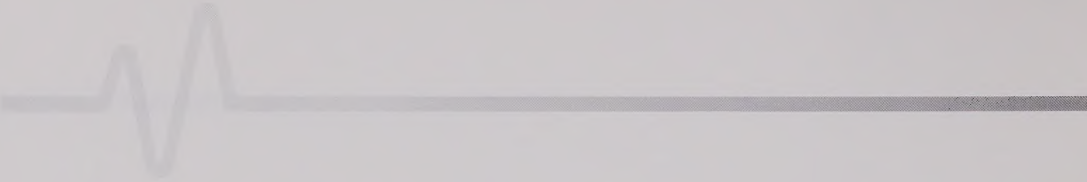
However, performing such mask tests can quickly become frustrating, for the following reasons:

- The oscilloscope is a general purpose instrument that is not optimized for any specific application. Setting it up for mask testing can be particularly tedious, and non-trivial.
- Some adjustments, particularly horizontal ones, need to be performed frequently during mask testing. Making these adjustments manually is not only cumbersome, but may even be impossible if the oscilloscope is used in an automated test station.
- Some tests require either amplitude and peak adjustment or special triggering to isolate the correct pattern — also difficult if not impossible to achieve using a standard oscilloscope.

The Solution

LeCroy’s innovative Mask Tester application is designed to address these issues, and is ideal for Manufacturing Testing, Type Approval and Field Testing applications. The Mask Tester supports the major electrical bit rates in telephony, from both ITU G.703 and ANSI T1.103 standards. Its leading features include:

- One-step loading of masks and instrument setups
- Mask-to-signal alignment even on random bit streams
- Choice of fail actions such as screen printout, “beep”, “stop test” and “store failed trace”
- A complete set of twisted-pair and 75 Ω adapters, providing adequate cable termination and exact amplitude scaling.



Available Mask Tests

The Mask Tester application is available in two packages: ANSI and ITU. LeCroy's MT01 supports most ITU G.703 masks, and MT02 most ANSI T1.102 masks. A bundled package supporting both standards, MT01/02, is also available.

MT01 — ITU G.703

Signal	Bit Rate	Line Impedance	LeCroy Adapter
E-1	2.048 Mb/s	120 Ω twisted pair	AP120
E-1	2.048 Mb/s	75 Ω coax	PP090
E-2	8.448 Mb/s	75 Ω coax	PP090
E-3	34.368 Mb/s	75 Ω coax	PP090
E-4	139.264 Mb/s	75 Ω coax	PP090
STM-1E	155.520 Mb/s	75 Ω coax	PP090

MT02 — ANSI T1.102-1993

Signal	Bit Rate	Line Impedance	LeCroy Adapter
DS1	1.544 Mb/s	100 Ω twisted pair	AP100
DS3	44.736 Mb/s	75 Ω coax	PP090
STS-1	51.840 Mb/s	75 Ω coax	PP090
STS-3	155.520 Mb/s	75 Ω coax	PP090

Preparing the Test

Choosing the Right Adapter for the Right Signal

75 Ω Coax Signals

Plug-in the PP090 on the oscilloscope's desired channel connector. The PP090 will provide the correct 75 Ω impedance adaptation.

Then connect your signal using a 75 Ω cable to the PP090.

Twisted-Pair Signals

Use the appropriate adapter supplied in your package:

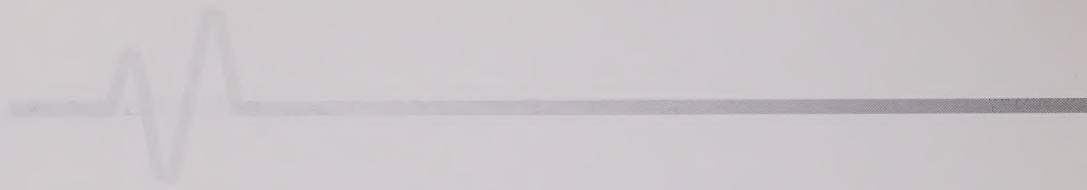
- For **DS-1 signals**, use the **AP100**.
- For **2 Mb/s twisted pairs**, use the **AP120**.

These adapters automatically ensure proper termination, convert the balanced signal into an unbalanced 50 Ω input, and scale the amplitude with the appropriate factor.

Test Signal Configuration

All tested signals can be random-bit streams, for optimum convenience and flexibility.

If the signal is not random or PRBS, ensure that it contains valid isolation patterns in order that the oscilloscope's pulse isolating mechanism can operate properly. *The required isolation patterns are described in Appendix A.*



Setting-Up the Oscilloscope

1. **Before the instrument is powered-up, plug in the PP100 accessory at the CAL BNC connector.** This is your software key to the Mask Tester application. As soon as it is plugged in, the oscilloscope will be dedicated to mask testing, and can be controlled only by using the seven menu buttons and two menu knobs to the immediate right of the screen. Each of these buttons and knobs corresponds to and controls the on-screen menu appearing beside it. Beneath them on the scope front panel is the RETURN button, an important navigation control that enables return to a higher menu level or the previous menu.
2. **Power-up the oscilloscope.**
3. **Plug in the SRAM card labeled MT01, MT02 or MT01/02 containing the masks and instrument setups at the slot located on the lower right-hand side of the front panel.**

Tip: *Toggling from Mask Tester to standard oscilloscope operation is easily done by pressing the button on the PP100.*

You are now ready to run the test!

Running the Test

The test proceeds in three steps:

1. **Selecting** the signal type
2. **Adjusting** the trace, and the test options
3. **Testing**.

The following pages detail these steps.

1. Selecting

TELECOM SETUP

signal type

DS-1
DS-3
STS-1
STS-3E
2M tp

NEXT...

source

1 2 3 4

1 GS/s

signal type

This is the top menu. Scroll through the list to select the appropriate signal type using the two top-most menu buttons alongside the menu.

NEXT...

Press the corresponding menu button beside this menu to access the "TRACE ADJUST" trace adjustment and test options menus (*shown next page*).

source

Select the desired channel and connect the signal under test to it using the appropriate adapter (*see above and page 9*).

2. Adjusting

The Trace

Case 1

Simple Masks in Volts (ITU 2, 8, 34 Mb/s)

TRACE ADJUST

IF test
Fails. do...

HORIZONTAL
ALIGN

attenuation
(Factor)
1.000

DO TEST
NOW

500 MS/s

If test fails, do...

Press the button corresponding to this menu to choose the action the oscilloscope should perform when a trace fails (see page 9).

HORIZONTAL ALIGN

Pressing the button for this menu causes the instrument to recalculate its trigger position to readjust the signal to the mask.

attenuation factor

Use the knob associated with this menu to compensate for any amplitude loss caused by the signal path. Pressing the corresponding menu button resets the value to 1.

DO TEST NOW

Once all adjustments and action setups have been made, start the test using this menu's button.

Case 2

CMI masks (STM-1E, STS-3E and 139 Mbps)

TRACE ADJUST

IF test
Fails, do...

offset
0 mV

VERTICAL
ALIGN

HORIZONTAL
ALIGN

attenuation
(Factor)
1.000

DO TEST
NOW

1 GS/s

If test fails, do...

Press the button corresponding to this menu to choose the action the oscilloscope should perform when a trace fails (see page 9).

VERTICAL ALIGN

Press this menu's button to adjust the signal offset, possible within a ± 50 mV range. If the required adjustment is outside this range, the warning message "Offset out of range, cannot do test" will be displayed.

HORIZONTAL ALIGN

Pressing the corresponding button causes the instrument to recalculate its trigger position and readjust the signal to the mask.

attenuation factor

Use the knob associated with this menu to compensate for any amplitude loss caused by the signal path. Pressing the menu button resets the value to 1.

DO TEST NOW

Once all adjustments and action setups have been made, start the test using this menu control.

Case 3

Normalized masks (ANSI DS-1, DS-3, STS-1)

TRACE ADJUST

IF test
Fails, do...

AUTO-FIT
TO MASK

averaging
OFF ☒ On
127

DO TEST
NOW

1 GS/s

If test fails, do...

Press the button corresponding to this menu in order to choose the action the oscilloscope should perform when a trace fails (see page 9).

AUTO-FIT TO MASK

Pressing the corresponding button will cause the signal to be re-normalized to its mask: amplitude and trigger position will be readjusted.

averaging

The signal under test may be averaged using this button. The knob selects the continuous averaging weighting.

DO TEST NOW

Once all adjustments and action setups have been made, start the test using this control (page 10).

The Test Options

The menus shown on this page are displayed when the "If test fails, do" menu button is pressed. They determine what the instrument does when a trace fails the test.

ACTION CHOICE

if test
Fails, then

stop

NoYes

store

NoYes

hardcopy

NoYes

beep

NoYes

500 MS/s

stop

Select **"Yes"** with the corresponding button to stop the acquisition.

store

Select **"Yes"** here to store the failed trace to memory card.

hardcopy

"Yes" to make a hardcopy of the screen using the internal printer.

beep

"Yes" to emit a sound.

3. Testing

These menus are displayed when the "DO TEST NOW" menu button is pressed.

Case 1

2, 8 and 34 Mb/s

TEST CONTROL	
Paused	
CONTINUE	
polarity positive negative	
passed	75
total	75
Fail	0 %
STOP TEST NOW	
1 GS/s	

PAUSE/CONTINUE

Press this menu's button to pause or continue the test without resetting the pass/fail count.

STOP TEST NOW

Press the corresponding button to stop the test. The pass/fail counter will be reset.

Case 2

STM-1E, STS-3E and 139 Mb/s

TEST CONTROL

Running

PAUSE

symbol
(value)
0 1

passed 0
total 29

Fail 100.00 %

STOP TEST
NOW

1 GS/s

PAUSE/CONTINUE

Press this menu's button to pause or continue the test without resetting the pass/fail count.

symbol

Press the corresponding button to toggle between "1" and "0" patterns. The pass/fail counter will be reset.

STOP TEST NOW

Press the corresponding button to stop the test. The pass/fail counter will be reset.

Case 3

DS-1, DS-3 and STS-1

TEST CONTROL

Paused

CONTINUE

polarity
positive
negative

passed 75
total 75

Fail 0 %

STOP TEST
NOW

1 GS/s

PAUSE/CONTINUE

Press this menu's button to pause or continue the test without resetting the pass/fail count.

polarity

Use the corresponding button to toggle between positive and negative pulses. The pass/fail counter will be reset.

STOP TEST NOW

Press the corresponding button to stop the test. The pass/fail counter will be reset.

Mask Testing by Remote Control: Commands

IDENTIFICATION

CU_OPT?
Query

DESCRIPTION The CU_OPT? query identifies the oscilloscope's custom options. The response consists of a series of response fields listing all the installed options.

QUERY SYNTAX CU_OPT?

RESPONSE FORMAT CU_OPT <option_1>, <option_2>,...,<option_n>
<option_n> = MT01 : Mask Tester option for ITU
MT02 : Mask Tester option for ANSI
0 : No custom options installed

CUSTOM_APPLICATION, CUAP
Command/Query

DESCRIPTION The CUSTOM_APPLICATION command toggles from Mask Tester to standard oscilloscope, emulating the button on the PP100 software key.

COMMAND SYNTAX CUSTOM_APPLICATION <state>

QUERY SYNTAX CUSTOM_APPLICATION?

RESPONSE FORMAT CUSTOM_APPLICATION <state>
<state> = OFF for the standard oscilloscope state
MASK_TESTER for the Mask Tester state

SELECTING

MT_SELECT_TEST

Command/Query

DESCRIPTION

The MT_SELECT_TEST command selects the signal/test type, and performs "AUTOALIGN" or "HORIZONTAL ALIGN" actions automatically on the signal.

COMMAND SYNTAX

MT_SELECT_TEST <test_name>, <channel>[👉], <averaging>[👉]

QUERY SYNTAX

MT_SELECT_TEST?

RESPONSE FORMAT

MT_SELECT_TEST <test_name>, <channel>, <averaging>
<test_name> = NO_TEST if no test selected
<test_name>: = { 2M_TP, 2M_COAX, 8M, 34M, 139M, 156M, DS1, DS3, STS1, STS3E}



AVAILABILITY

<channel>

On 4 channel oscilloscopes:

for 2M_TP, 2M_COAX, 8M, DS1: {C1, C2, C3, C4}

for 34M, 139M, 156M, DS3, STS1, STS3E {C2, C3}

On 2 channel oscilloscopes:

for 2M_TP, 2M_COAX, 8M, DS1: {C1, C2}

for 34M, 139M, 156M, DS3, STS1, STS3E {C2}

<averaging> available only for DS1, DS3, STS1

Note: Autoalign and Horizontal Align actions are performed automatically using the MT_SELECT_TEST command.

**OPERATION
COMPLETE**

MT_OPC?
Query

DESCRIPTION

The MT_OPC? (OPeration Complete) query checks the completion of the following commands.

MT_SELECT_TEST

MT_VERTICAL_ALIGN

MT_SYMBOL

The query returns a "0" while the command is not completed, and a "1" otherwise.

QUERY SYNTAX

MT_OPC?

RESPONSE FORMAT

MT_OPC <state>

<state> = {0, 1}

ADJUSTING

MT_VERTICAL_ALIGN

Command

DESCRIPTION

Performs offset alignment for STM-1E, STS-3E and 139M.

COMMAND SYNTAX

MT_VERTICAL_ALIGN

MT_OFFSET

Query

DESCRIPTION

Returns the offset value for STM-1E, STS-3E and 139M.

QUERY SYNTAX

MT_OFFSET?

RESPONSE FORMAT

MT_OFFSET <offset_value> mV

MT_ATTENUATION

Command/Query

DESCRIPTION

Controls cable attenuation factor for 2M_TP, 2M_COAX, 8M, 34M, 139M, 156M.

COMMAND SYNTAX

MT_ATTENUATION <attn_value>

QUERY SYNTAX

MT_ATTENUATION?

RESPONSE FORMAT

MT_ATTENUATION <attn_value>
<attn_value> = value between 0.5 and 1

ADJUSTING

MT_FAIL_ACTION

Command/Query

DESCRIPTION

Controls the actions the instrument should perform when a test fails.

COMMAND SYNTAX

MT_FAIL_ACTION <action>[,<action>]

QUERY SYNTAX

MT_FAIL_ACTION?

RESPONSE FORMAT

MT_FAIL_ACTION <action>[,<action>]
<action> := {STOP, STORE, DUMP, BEEP}

TESTING

MT_TEST_STATE

Command/Query

DESCRIPTION	Controls the test execution: RUN/STOP or PAUSE/CONTINUE).
COMMAND SYNTAX	MT_TEST_STATE <test_state>
QUERY SYNTAX	MT_TEST_STATE?
RESPONSE FORMAT	MT_TEST_STATE <test_state> <test_state> := {RUN, STOP, CONTINUE, PAUSE}

MT_SYMBOL

Command/Query

DESCRIPTION	For STM-1E, STS-3E and 139 M selects the “1” or “0” symbol. For DS1, DS3 and STS1 selects the “POS” or “NEG” pulse.
COMMAND SYNTAX	MT_SYMBOL <bit_value>
QUERY SYNTAX	MT_SYMBOL?
RESPONSE FORMAT	MT_SYMBOL <bit_value> <bit_value> := { 0, 1, POS, NEG}

MT_PF_COUNTERS

Query

DESCRIPTION	Controls the test execution: RUN/STOP or PAUSE/CONTINUE).
QUERY SYNTAX	MT_PF_COUNTERS?
RESPONSE FORMAT	MT_PF_COUNTERS PASS,<nb_pass>,OF,<nb_tot>,FAIL_RATE,<fail_rate> <nb_pass> = <nb_tot> = unsigned long int <fail_rate> = double

Appendix A: Specifications

Name	Bit rate [Mb/s]	Pulse	Impedance	Coding	Isolation Required	Isolation Pattern
MT01 — ITU G.703						
2 M TP	2.048	pos/neg	120 Ω	HDB3	NO	
2 M Coax	2.048	pos/neg	75 Ω	HDB3	NO	
8 M Coax	8.448	pos/neg	75 Ω	HDB3	NO	
34 M	34.368	pos/neg	75 Ω	HDB3	NO	
139 M	139.264	zero/one	75 Ω	CMI	YES	1010/1001
STM-1E	155.520	zero/one	75 Ω	CMI	YES	1010/1001
MT02 — ANSI T1.103						
DS-1	1.544	pos/neg	100 Ω	AMI or B8ZS	YES	000010 0000-10
DS-3	44.736	pos/neg	75 Ω	B3ZS	YES	0010/00- 10
STS-1	51.840	pos/neg	75 Ω	B3ZS	YES	0010/0010
STS-3E	155.520	zero/one	75 Ω	CMI	YES	1010/1001

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